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**Research Document 2006/065** | **Document de recherche 2006/065**

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# Atlantic Halibut on the Scotian Shelf and Southern Grand Banks (Div. 3NOPs4VWX5Zc) – Industry/DFO Longline Survey Results to 2005

# Flétan du plateau Néo-écossais et du sud des Grands Bancs (div. 3NOPs4VWX5Zc) – résultats du relevé à la palangre réalisé par l'industrie et le MPO jusqu'en 2005

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* La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

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ISSN 1499-3848 (Printed / Imprimé)
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## ABSTRACT

The industry/DFO Atlantic halibut longline survey has been in operation for eight years. During this time, there has been no indication of a change in halibut distribution within the management unit area, 3NOPs4VWX. Overall, there appears to be relative stability in the adult abundance within the fixed station survey, and its size composition indicates there has been no depletion of large fish from the population. The commercial index catch rate shows a decline from 2002 to 2004; however this index is more complex than the fixed station survey, and not all sources of variability have been considered at this time. The number of pre-recruits (fish < 81cm) from the fixed station declined from 2001 to 2004; but in 2005 pre-recruits increased in both the DFO research vessel (RV) survey and the halibut long-line survey, however, there is some uncertainty over the survey's 2005 data point. Given this information, there was no basis to advise a change in the current fishing levels for 2006-07. Station coverage and NAFO division coverage has been erratic over the course of the survey. A reduction in participation in 2005 was a result of increased cost of fishing operations. It is vital that the survey consistently covers the 72 stations that have been completed in every year of the survey, and that the survey consistently covers the entire management unit area, including 3NOPs. The longline survey is effectively monitoring the direction of change in relative population abundance of Atlantic halibut over time, and its continued operation is essential to the management of the fishery. Results from new research projects including an otolith aging study and a mark-recapture project are expected to provide a greater understanding of the population status, and are anticipated for 2008.

## RÉSUMÉ

Un relevé du flétan de l'Atlantique à la palangre est réalisé par l'industrie et le MPO depuis maintenant huit ans. Pendant cette période, rien n'a indiqué qu'il y ait eu de changement manifeste dans la répartition du flétan au sein de l'unité de gestion 3NOPs4VWX. Dans l'ensemble, on constate une stabilité relative de l'abondance des adultes dans le relevé en stations fixes, et la composition selon la taille montre qu'il n'y a pas eu de perte des grands poissons parmi la population. Le taux de prises dans la phase d'indice commercial dénote un déclin de 2002 à 2004. Toutefois, cette phase du relevé est plus complexe et les sources de variabilité qui y sont associées n'ont pas toutes été prises en compte. Le nombre de prérecrues (poissons < 81 cm) dans la phase en stations fixes a diminué de 2001 à 2004; en 2005, le nombre il a augmenté aussi bien dans le relevé du navire de recherche du MPO que celui de l'industrie à la palangre. Cependant, il y a de l'incertitude au sujet du point de données de 2005. Dans ces circonstances, rien ne porte à recommander un changement du taux d'exploitation actuel pour 2006-2007. Le nombre de stations et l'étendue des divisions de l'OPANO qui ont été inclus dans les relevés ont été irréguliers selon les années. La réduction de la participation en 2005 résultait d'une augmentation des coûts des activités de pêche. Il est essentiel que le relevé englobe systématiquement les 72 stations qui ont été échantillonnées à chaque année de relevé, ainsi que toute l'étendue de l'unité de gestion, y compris 3NOPs. Le relevé à la palangre sert à surveiller efficacement l'orientation du changement d'abondance relative de la population de flétan de l'Atlantique au fil du temps, de sorte que sa poursuite est essentielle à la gestion de cette pêche. De nouveaux projets de recherche, y compris une étude de détermination de l'âge à l'aide des otolites et un projet de marquage et recapture dont on devrait obtenir les résultats en 2008, devraient permettre de mieux comprendre l'état de la population.

## INTRODUCTION

Atlantic halibut (*Hippoglossus hippoglossus*) is the largest of all flatfish and ranges widely over Canada's East Coast (Bigelow and Schroeder, 1953). They are demersal, living on or near the bottom, at temperatures within a few degrees of 5°C (Neilson *et al.*, 1993; Bowering, 1986). Atlantic halibut are most abundant at depths of 200-500 m in the deep-water channels running between the banks and along the edge of the continental shelf, with larger individuals moving into deeper water in winter (Bowering, 1986). The management unit definition (3NOPs4VWX5Zc) (Fig. 1) was based largely on tagging results that indicated that Atlantic halibut move extensively throughout the Canadian North Atlantic with smaller fish moving further than larger fish (Stobo *et al.*, 1988). Migrations of larger fish are thought to be related to spawning. Studies have shown that the Browns Bank area may be an important rearing area for juvenile halibut and that there is a north-eastward movement of fish as they grow (Stobo *et al.*, 1988). The geographic range of Atlantic halibut in the Northwest Atlantic extends from the coast of Virginia in the south to the waters off Disko Bay, Greenland in the north (Scott and Scott, 1988; Bowering, 1986). Since the early 1990s, there appears to have been a significant reduction in the numbers of halibut in the extremes of its range, in US waters (Kanwit, 2007) and along the Labrador Shelf (NAFO and ZIF).

Although the growth and maturity cycles of Atlantic halibut require further study, it appears that females grow faster than males, and attain a much larger maximum size (Trumble *et al.*, 1993). Females reach 50% maturity at about 115cm, while males reach 50% maturity at about 75cm. In the absence of reliable growth information, age at maturity remains uncertain. Halibut are voracious feeders and up to a length of 30cm, food consists almost exclusively of invertebrates (Kohler, 1967). Between 30cm and 66cm, both invertebrates and fish are consumed, while halibut over this size eat fish almost exclusively.

Landings of Atlantic halibut have been recorded for the east coast of Canada since 1883. Average landings from 1960 to 2005 for this region have been approximately 1900t annually. Until 1988, the fishery was unregulated. A TAC of 3200t was imposed in 1988, and held in place until 1994, when it was reduced to 1500t, followed by a further reduction in 1996 to 850t (Fig. 2). Reductions in the TAC were implemented in response to an eight year decline in landings, a decision that continues to be a topic of significant debate among stakeholders. In 1999, recommendations made by the Fisheries Resource Conservation Council (FRCC) resulted in increases to the TAC for this stock from 850 to 1000t; two further increases were implemented to achieve the present TAC level of 1300t. Landings for the 2005-06 fishing season were 1253t (Table 1). Within the management unit, halibut is fished nearshore and offshore mainly by longliners using bottom hook-and-line gear. Since 1994, management plans and license conditions require the release of halibut less than 81cm. The halibut fishery catches halibut as part of a suite of species, which includes most notably, white hake, cusk, and cod. The relative proportions of these vary with location and time of year.

Information on Atlantic halibut has been gathered by DFO research vessel (RV) trawl surveys since 1970, but has been based on few halibut samples since they are rarely caught in survey tows. Since RV survey estimates for adult (≥81cm) halibut abundance are considered to be unreliable estimates for adult biomass, an industry/DFO longline halibut survey on the Scotian Shelf and Southern Grand Banks (3NOPs4VWX5Zc) was initiated in 1998. Using a 100t catch limit (Fig. 2), the industry/DFO halibut survey provides reliable estimates of abundance and distribution for Atlantic halibut that are used as input for an annual assessment. This survey also generates reliable estimates of population size structure, including indications of incoming recruits.
In 2005, advice requested by Fisheries Management on the stock status of 3NOPs4VWX5Zc halibut to determine a TAC consistent with the management plan included issues listed below and as addressed form the basis of this document. The remit was:

- What are the current removals, including surveys, and commercial bycatch of Atlantic halibut?
- What are the recent catch rate and distribution trends from the Atlantic halibut industry survey?
- Evaluate whether or not these trends indicate positive or negative stock status. Report on these trends for small (<81cm) and large (≥81cm) fish.

## METHODS AND MATERIALS

### DFO Research Vessel (RV) Trawl Surveys

The annual DFO Scotian Shelf groundfish RV survey has been conducted every year during the month of July since 1970. Each year, 231 fishing stations are sampled from the Upper Bay of Fundy to the Northern tip of Cape Breton and offshore to the 400 fathom contour (app. 700m) (Branton and Black, 2004). Because RV trawl surveys have a low catchability for adult halibut (>81 cm), the adult catch is highly variable from year to year, and is considered to be an unreliable index of adult abundance. Fishery recruitment can, however, be estimated since the modal size of halibut caught in the trawl survey is between 40 and 50 cm. The number of fish <81 cm caught annually provides an estimate of pre-recruits entering the fishable population.

### The Industry/DFO Longline Halibut Survey

Since the DFO RV survey estimates of adult (≥81cm) halibut abundance were considered unreliable, an industry/DFO longline halibut survey on the Scotian Shelf and Southern Grand Banks (3NOPs4VWX5Zc) was initiated in 1998 using a 100t halibut catch limit (Fig. 2). This survey was designed to provide estimates of abundance and distribution for Atlantic halibut to provide input to an annual assessment. The survey also yields estimates of population size structure, including indications of incoming recruits. The survey consists of two phases: a fixed

station phase and a commercial index phase. During the fixed station phase, 275 pre-selected locations are available to be fished using prescribed survey fishing protocols (hook-size, number of hooks, and minimum soak times) (Zwanenburg and Wilson, 2000a, 2000b, 2003; for detailed description of survey protocols). During the commercial index phase, survey participants fish with their own fishing protocols and locations of their choosing. Catches for each phase of the survey are shown in Table 2.

**Distribution**

Standardised catch was plotted by year to show halibut distributions for the two phases of the survey (Figs. 3 and 4).

**Fixed Station Catch Rates and Stratified Catch Rates**

Fixed station catch rate estimates are based on catch rates per standardised longline set, defined as 1000 hooks set for 10 hours and adjusted to standard catch rates using:

(1) Adjusted catch = (raw catch x (1000 / #of hooks set)) x (600 / # minutes soaked)

The fixed station phase of the survey utilizes a stratification system designed to produce a stratum-weighted estimate of mean catch rate, where strata have been based on the distribution of observed landings by trip for the period 1993 – 1997 (Zwanenburg and Wilson, 2003). Three strata were defined using high (> 250 kg), medium (50 – 249 kg) and low (<49 kg) landings. The area of each stratum was estimated using potential mapping with a radius of influence for each observation sufficient to define a stratum for all areas of the survey area. Weighted catch rate estimates were done using

(2) $\sum_{i=1}^{i=3}$ (mean standard catch for stratum i) x (area of stratum i/total area of all strata)

Three separate analyses of Atlantic halibut catch rates were compared to determine whether irregular station sampling over the course of the survey affected the catch rate estimate. The three analyses were: 1) data for all stations done in the entire survey period (n = 159 to 229, Fig 5), 2) data for all stations done in the entire survey period fitted to a general linear model with a negative binomial error distribution, and 3) data for stations only completed in each and every year of the survey (n = 72).

**Commercial Index Catch Rates**

Commercial index catch rates calculation is similar to those of the fixed station (see equation 1). Within the commercial index phase, the participants fish with their own fishing protocols and locations, although the fishing protocol tends to be the same as that using in the fixed station phase.

**Pre-Recruits Index**
The total number of small (<81 cm) and large (<81 cm) fish caught each year in the halibut longline survey are estimated exclusively from the fixed station phase sets of the survey because there is 100% onboard observer coverage to ensure all fish are counted and measured.

To understand the influence intermittent station sampling had on fixed station pre-recruitment estimates, the pre-recruitment data underwent two analyses: 1) data for all stations done in the entire survey period divisions (n = 159 to 229, Fig 5), and 2) data for stations only completed in each and every year of the survey (n = 72)

**Size Composition**
Size composition of adult halibut caught in the fixed station and commercial index phases of the survey were described by the $50^{th}$ (median) and $95^{th}$ percentiles of fish lengths, which were taken from the length frequency distributions. The $95^{th}$ percentile is the size of the top 5% of the largest fish, while the 50% percentile is the length of halibut that falls in the middle of the size distribution. These values were tracked over the course of the survey.

## RESULTS AND DISCUSSION

**Survey Coverage**
Participation in the halibut longline survey has waxed and waned since 1998. In 2005, there were concerns over a reduction in the number of sets completed in both phases when compared to previous years. With 11 vessels contributing, 2005, was one of three years with the lowest level of participation (Table 3, Fig. 5). Of the 275 pre-selected fixed station locations, 176 were completed in 2005 by these 11 vessels.

Over the course of the survey, station coverage in the fixed station phase has been irregular. Of the 275 fixed station locations (Fig. 6), only 72 have been completed in all years of the survey (Table 4). Conclusions about the fixed station catch rate are based on analyses using only these 72 stations. The importance of conducting these stations annually can not be overemphasized; they are critical to maintaining a continuous time series. Furthermore, increasing the number of stations occupied annually can only serve to increase the robustness of the survey.

Four new fixed stations (313, 314, 315, 316, see Fig. 6 and Table 4) were added to the survey area in 2005 to expand the sampling range in 4Vn. Station additions were made because large catches were made north of 46° in 4Vn, an area where there were no fixed station locations. Analyses of fixed station catch data and pre-recruit data incorporating the new stations showed large increases in the 2005 estimates; these stations were subsequently excluded from analyses in this document. These elevated estimates served to initiate an examination of the sets

completed per year (Table 4), and an examination of how irregular station sampling affected fixed station catch rate and pre-recruits.

Similar to the fixed station phase, fewer commercial index sets were done in 2005 than most of the previous years. The number of commercial sets dropped from 820 in 2004 to 506 in 2005, ranking 2005 as the second lowest year for commercial index set completion on record (Fig. 5). Should participation continue to drop, it will be necessary to determine the minimum number of sets required for reliable estimates.

In addition to erratic coverage of planned fixed station locations, NAFO divisions 3NOPs were not covered consistently in both phases throughout the survey period (1998 – 2005) due to the high cost of getting to these areas by Nova Scotia-based participants, and to the management restrictions of cod bycatch limits in 3Ps, which precludes conduct of the commercial index phase in this area.

Inconsistent coverage of 3NOPs caused large variability in the year to year estimates; consequently analyses were done using only data from the most consistently occupied survey area, 4VWX. Advice for the entire stock (3NOPs4VWX) is based on these analyses. The continued operation of the Industry/DFO longline survey to effectively monitor population status is essential to the management of this fishery and as such it is vital that the survey consistently covers 3NOPs.

Overall, the reduction in participation for the entire survey area was a result of increased cost of fishing operations, including higher fuel, bait, and labour costs, without a similar increase in the sale price of halibut.

**Distribution**

Despite variability in coverage, there was no obvious indication of a change in distribution of Atlantic halibut for the fixed station (Fig. 3) or commercial index (Fig. 4) phases of the survey.

A suggestion that halibut caught near the borders of the 3NOPs4VWX5Zc management unit area may belong to other management units (i.e. sub area 4RST) provides reason to develop a more precise definition of the boundaries.

**Fixed Station Catch Rates**

Three different analyses of Atlantic halibut catch rate in the fixed station phase of the survey were compared. All analyses showed stable trends with no significant changes throughout the survey period (Fig. 7, Table 5). Fixed station catch rates estimated by NAFO division are consistently highest in 4V followed by 4W and then 4X (Fig. 8); 4V is very stable, while 4W and 4X show some variability, but overall are also considered stable.

**Stratified Fixed Station Catch Rates**
Fixed station catch rates estimated for each of the three strata have shown some variability from year to year, but overall tend toward stability (Fig. 9). These results indicate that the relative catch rates observed between strata support the original stratification scheme, in that high catch rate strata consistently show the highest catch rates, and medium and low catch rate strata follow in order.

**Commercial Index Catch Rates**
Atlantic halibut catch rate in the commercial index phase of the survey shows a general decline from 2002 to 2004, with a significant decrease of 21% in 2004; and an increase in 2005 of 7% (Fig.10). Commercial index catch rates estimated by NAFO division are consistently highest in 4V and 4W and lower in 4X (Fig. 11). Combined declines in 4V and 4W catches caused the general four-year decline, while the significant decline seen in 2003, were a result of reduced catch in 4V.

Owing to this decline, the fixed station and commercial index catch rate trajectories are not entirely in agreement. The commercial index phase is considered to be more complex than the fixed station phase. The disparity between the two catch rates indices might be explained by examining factors affecting commercial index catch rate not currently accounted for in the analytical stage, such as changes in skippers, number of crew, amount of gear in the water, changes in soaktime, and a shift in effort within NAFO area.

**Pre-Recruitment**
The number of fish <81cm caught on the DFO RV trawl surveys indicate that recruitment has been low since 1993, however, the number of small fish in 2004 and 2005 are above average (0.183 per standard tow, 1970 - 2005) (Fig. 12).

The longline survey has a much higher catchability for pre-recruit halibut than the RV trawl survey and covers most of the stock area (Fig. 12). The number of fish <81cm caught on the fixed station phase of the halibut survey declined from 2001 to 2004. Depending on the number of stations included in the calculation, the pre-recruitment estimate for 2005 remains the same as 2004, or increased (Fig. 13). Two analyses of pre-recruitment in the fixed station phase of the survey were compared. Pre-recruits increased in 2005 when all stations were included in the estimate, (Figs. 12 & 13), however, when only stations completed in each and every year of the survey (n = 72) were used, the number of pre-recruits remained the same as 2004. A third, more rigorous analysis, where data for all stations done in the entire survey period is fitted to a general linear model with a negative binomial error distribution was not conducted. This third analysis on pre-recruitment data may clarify variable trajectories seen in 2005 using the first two analyses.

In 2005, the majority of pre-recruits were caught in 4X (Fig. 14); 4X consistently represented the area of the stock with the greatest proportion of fish <81cm caught during the survey period.

**Size Composition**

In the fixed station and commercial index phases of the survey, there is no evidence of a decline in the 95$^{th}$ percentile of fish lengths, indicating there has been no depletion of large fish from the population over the course of the survey (Figs. 15 & 16). Over the course of the survey, a trend of increasing fish size in the 95$^{th}$ percentile of fish in the commercial index indicates an increasing proportion of larger fish; this increase could be explained by participants focussing on catching small fish, that fishing practices changed somehow over time, or that survivorship is increasing thus the size of halibut being caught is increasing. However, when considered with the stability of this abundance index, it probably reflects no decrease in large fish.

## CONCLUSION

The longline survey has been in place for eight years and provides a reliable indicator of population abundance and population size structure, including indications of incoming recruits. Its continued operation is essential to the management of the fishery.

Based on the information arising from the advice request by Fisheries Management regarding the status of Atlantic halibut for the 2004 - 2005 season, there was no strong evidence to advise a change in the current fishing levels for 2006-07. This advice is based largely on the fixed station catch rates demonstrating stable trends with no significant changes throughout the survey period.

Station coverage and NAFO division coverage has been erratic over the course of the survey. A reduction in participation in 2005 was a result of increased cost of fishing operations. For the future, it is vital that the survey consistently covers the 72 stations that have been completed in every year of the survey, and that the survey consistently covers the entire management unit area, including 3NOPs.

Presently, the survey is not capable of providing an estimate of absolute population size, or overall mortality rates. Proposals for new research including an otolith aging study and a mark-recapture project are expected to provide a greater understanding of the Atlantic halibut population status.

## REFERENCES


Bigelow, H.B. and Schroeder, W.C. 1953. Fishes of the Gulf of Maine. Fishery Bulletin of the Fish and Wildlife Service, No. 74, 577 p.

Bowering, W.R. 1986. The distribution, age and growth and sexual maturity of Atlantic halibut (*Hippoglossus hippoglossus*) in the Newfoundland and Labrador area of the Northwest Atlantic. Can. Tech. Rep. Fish. Aquat. Sci. 1432:34p.

Branton, R. and G. Black. 2004. 2004 Summer Groundfish Survey update for selected Scotia-Fundy groundfish stocks. DFO Can. Sci. Advis. Sec. Res. Doc. 2004/108. 64p.

Kanwit, J.K., 2007. Tagging results from the 2000-2004 federal experimental fishery for Atlantic halibut (*Hippoglossus hippoglossus*) in the eastern Gulf of Maine. J. Northw. Atl. Fish. Sci., 38:37-42.

Kohler, A.C. 1967. Size at maturity, spawning season, and food of Atlantic halibut. J. Fish. Res. Bd. Canada, 24(1): 53-66.

Neilson, J.D., J.F. Kearney, P. Perley, and H. Sampson. 1993. Reproductive biology of Atlantic halibut (*Hippoglossus hippoglossus*) in Canadian waters. Can. J. Fish. Aquat. Sci. 50:551-563.

Scott, W.B. and M.G. Scott. 1988. Atlantic fishes of Canada. Can. Bull. Fish. Aquat. Sci. 219. 731 p.

Stobo, W., J.D. Neilson, and P. Simpson. 1988. Movements of Atlantic halibut (*Hippoglossus hippoglossus*) in the Canadian North Atlantic: inference regarding life history. Can. J. Fish. Aquat. Sci. 45:484-491.

Trumble, R.J., J.D. Neilson, W.R. Bowering, and D.A. McCaughran. 1993. Atlantic halibut (*Hippoglossus hippoglossus*) and Pacific halibut (*H. stenolepis*) and their North American Fisheries. Can. Bull. Fish. Aquat. Sci. 227:84pp.

Zwanenburg, K.C.T., and S. Wilson. 2003. Halibut on the Scotian Shelf and Southern Grand Banks – Overview of the Industry/DFO Longline Survey and Results to 2003. DFO Science Fisheries Status Report 2003/01: 30 p.

Zwanenburg, K.C.T., and S. Wilson. 1999. Halibut Survey on the Southern Grand Banks and Scotian Shelf. Participants Manual: 30 p.

Zwanenburg, K.C.T., and S. Wilson. 2000. Scotian Shelf and Southern Grand Banks Atlantic halibut (*Hippoglossus hippoglossus*) survey – Collaboration between the fishing and fisheries science communities. Theme session on Cooperative Research with the Fishing Industry: Lessons Learned. ICES 2000 Annual Science Conference.

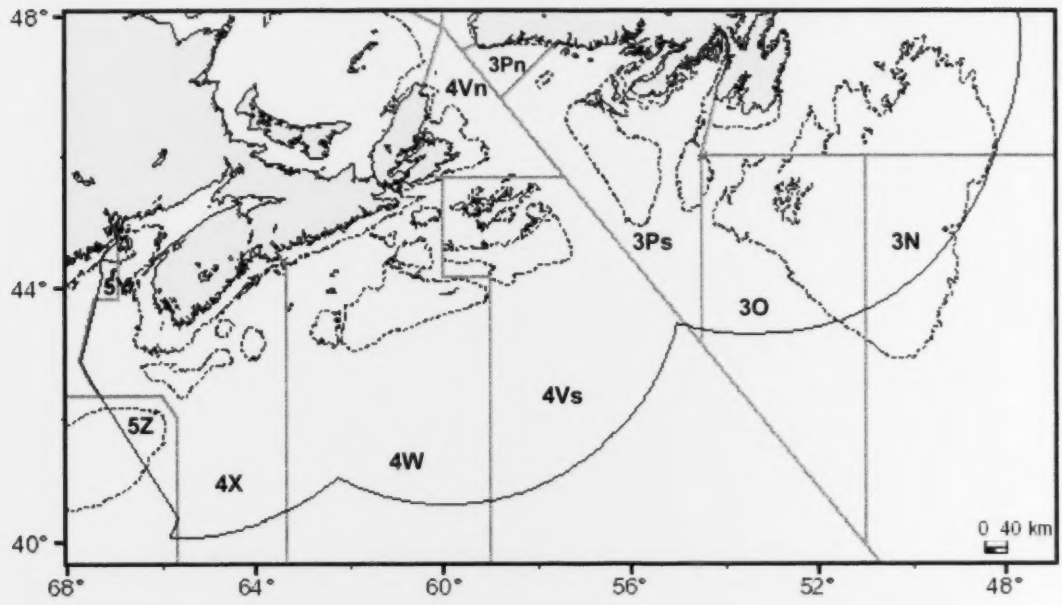


Figure 1. Map of the management unit definition (3NOPs4VWX5Zc) for Atlantic halibut.

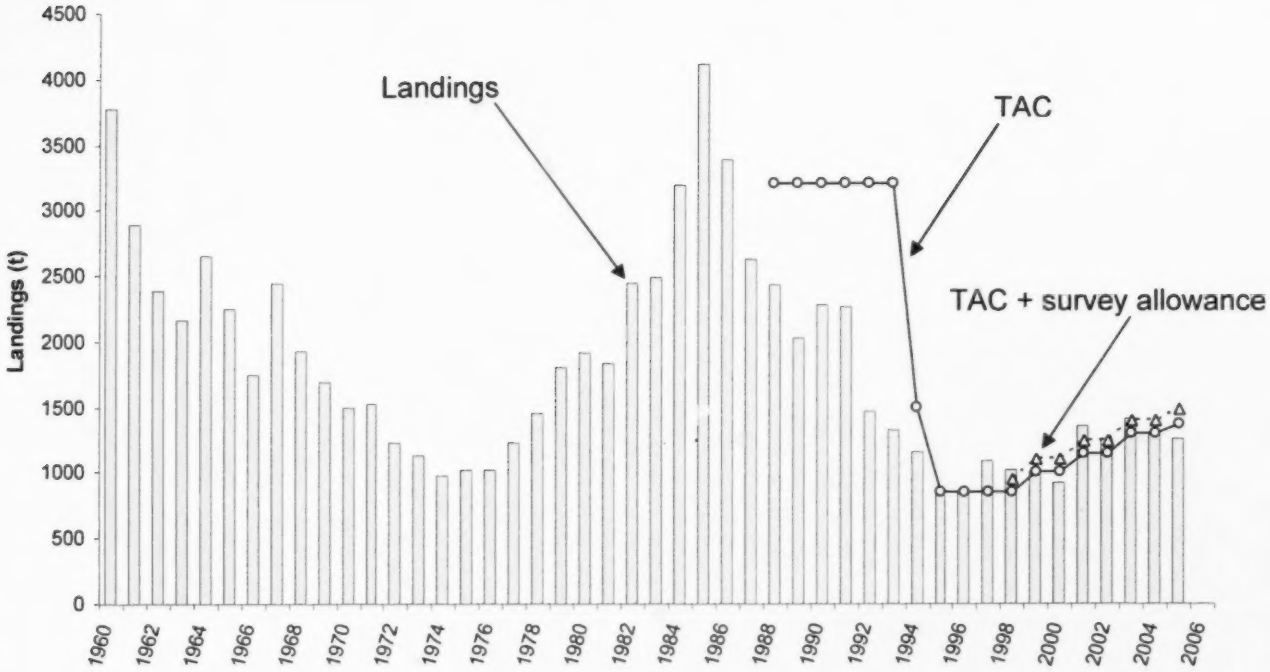


Figure 2. Landings, TAC, and survey catch limit for Atlantic halibut from the Scotian Shelf and Southern Grand Banks (3NOPs4VWX5Zc).

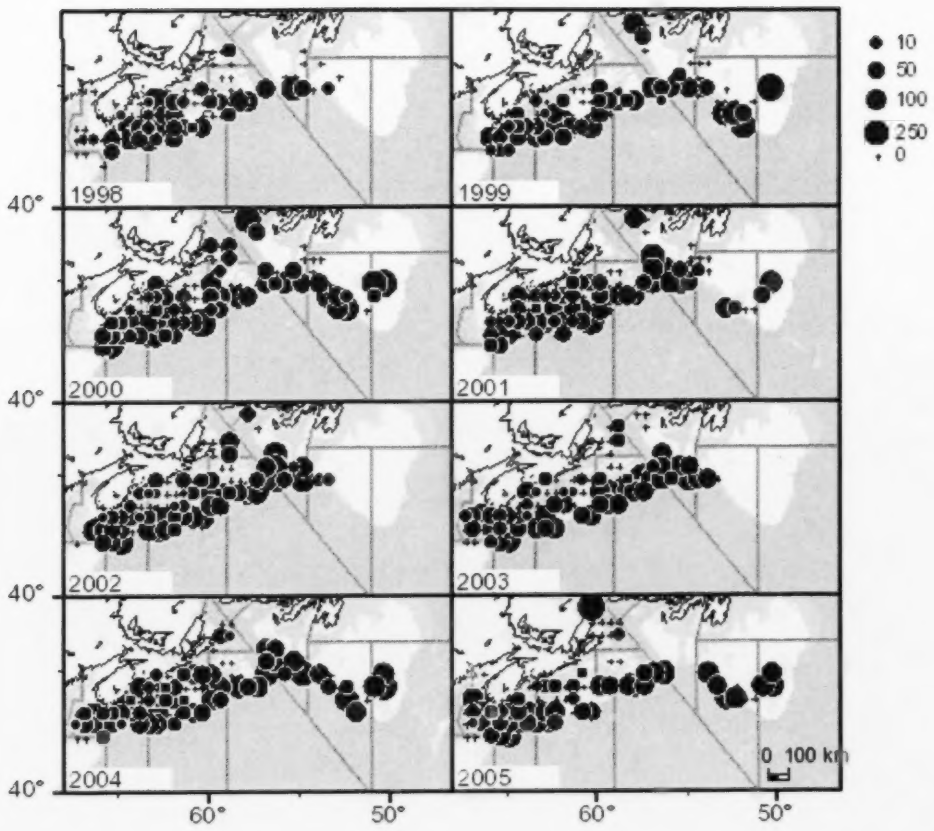


Figure 3. Fixed stations catch distribution of Atlantic halibut in the halibut survey. Circles in legend indicate total average weight (kg).

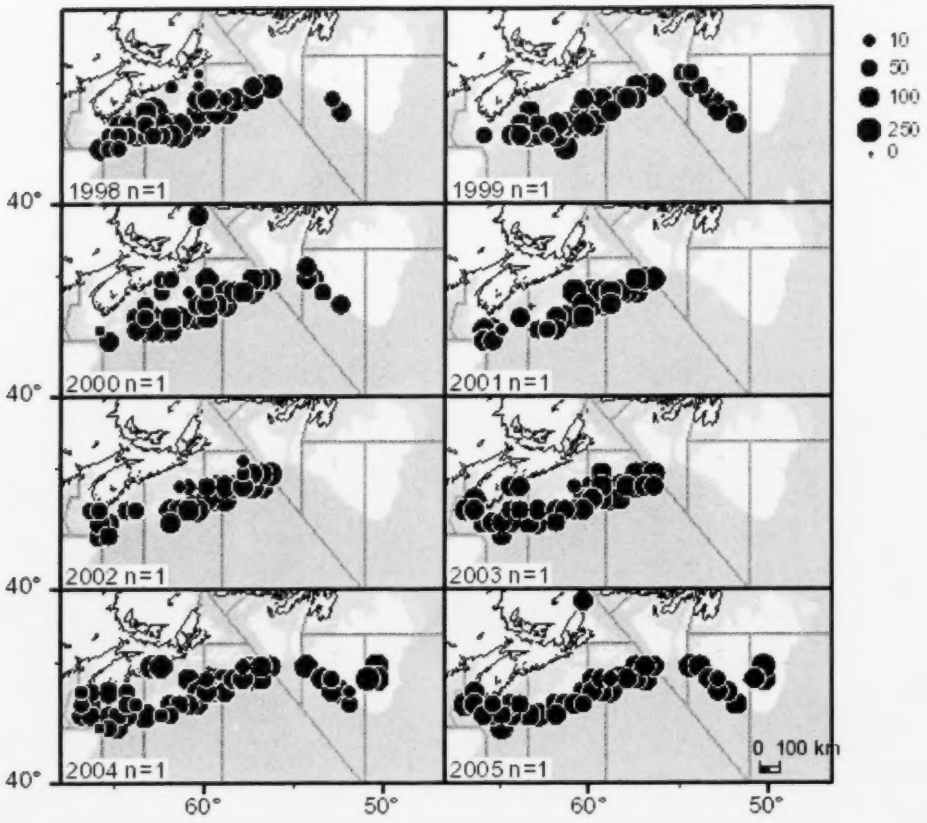


Figure 4. Commercial index catch distribution of Atlantic halibut in the halibut survey. Circles in legend indicate total average weight (kg).

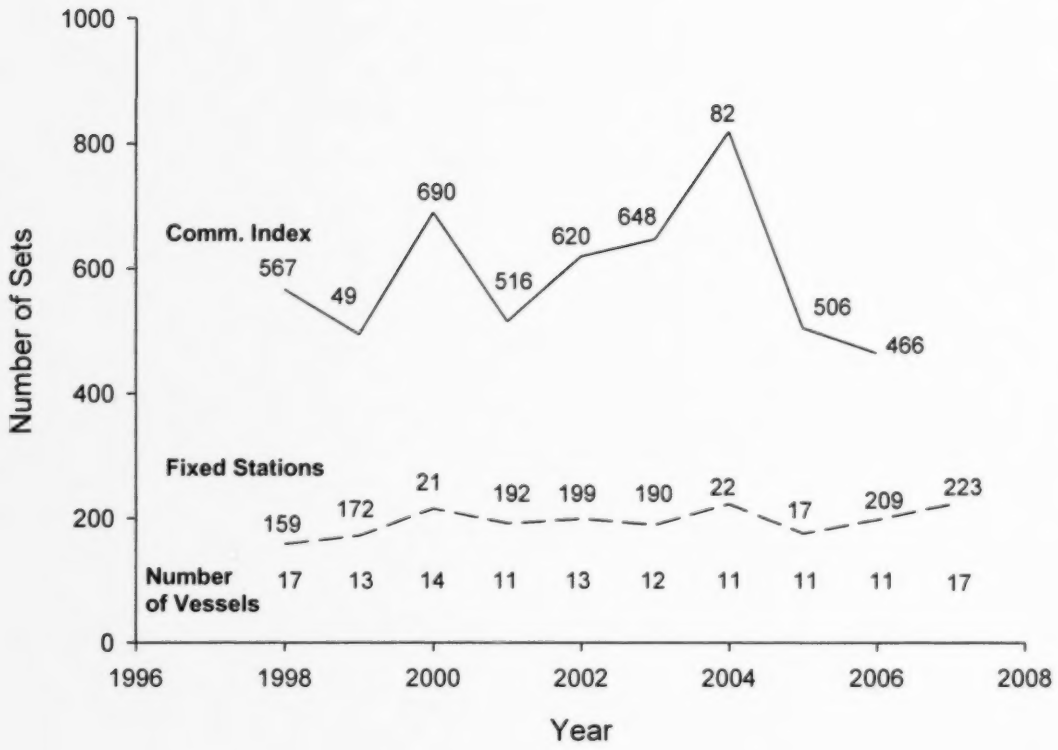


Figure 5. Number of vessels and number of sets completed per year in the fixed station and commercial index phases of the halibut survey. The number of vessels is the same for both indices.

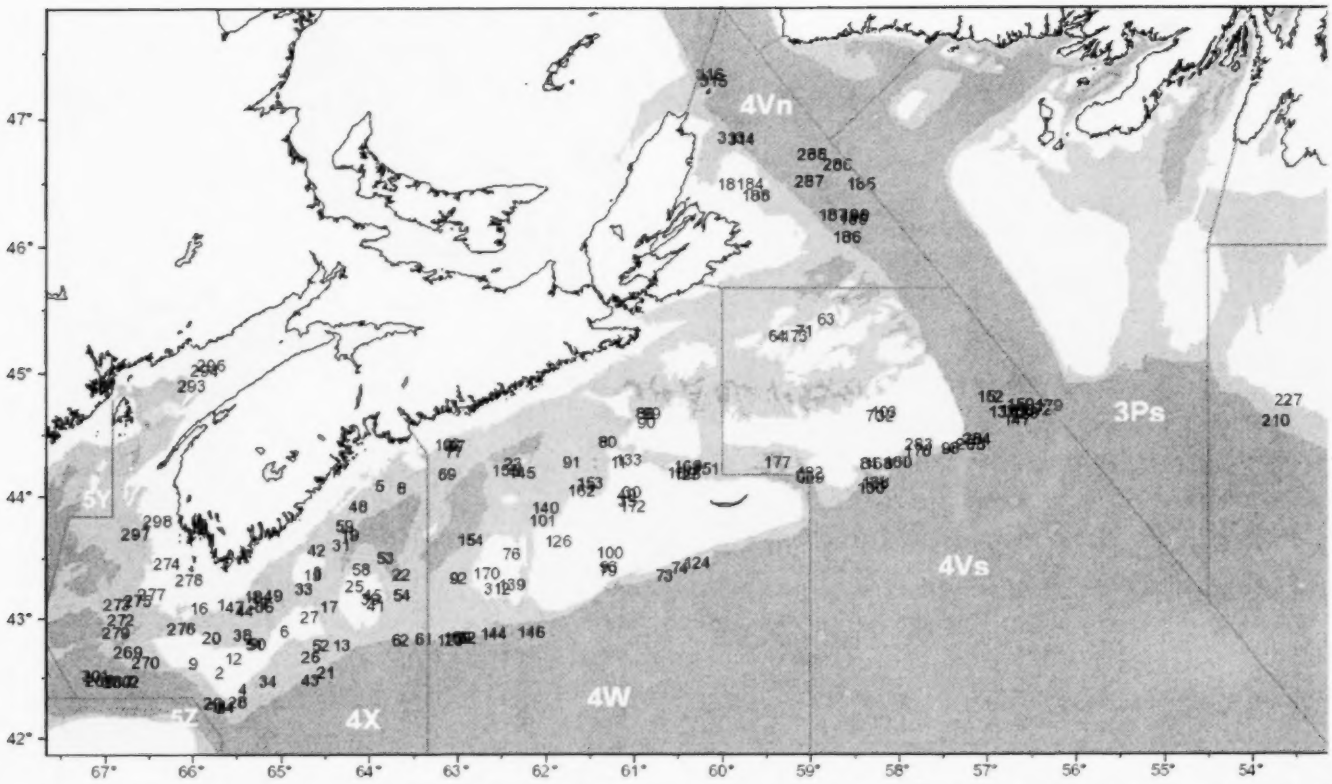


Figure 6. Halibut survey station locations in 2005; including 4 new stations in 4Vn (313, 314, 315, a

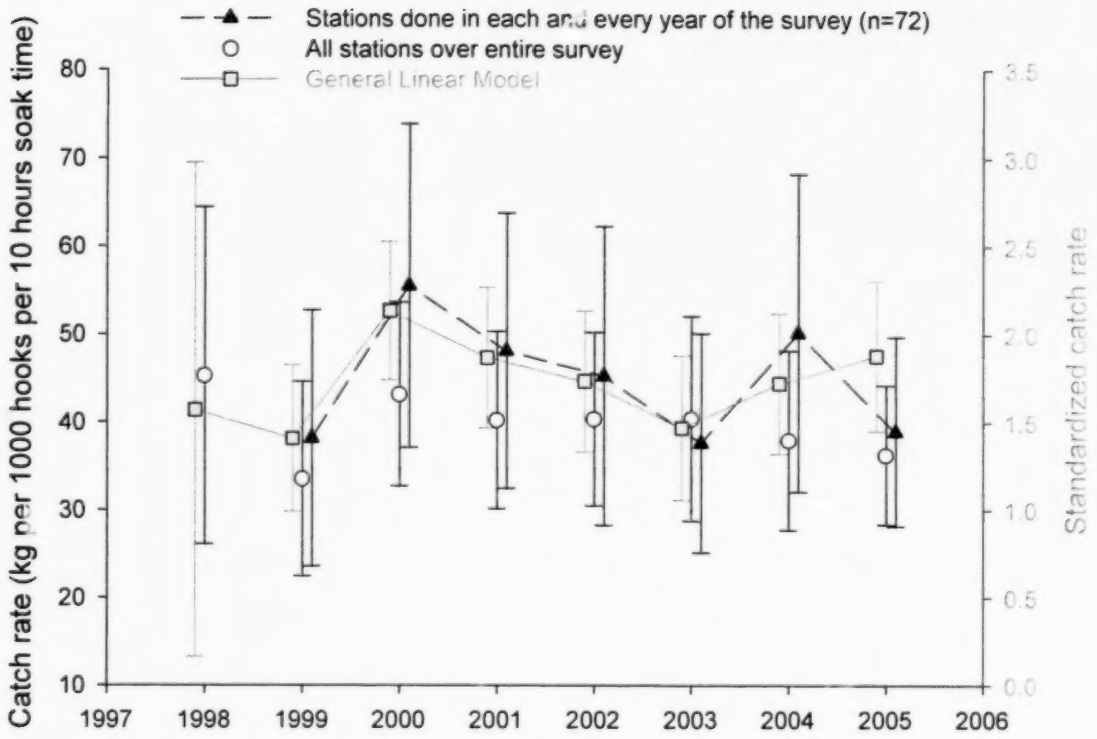


Figure 7. Three analyses for fixed stations catch rates (+/- 2SE) of Atlantic halibut in 4VWX from the halibut survey. See Table 5 for GLM analysis of deviance table.

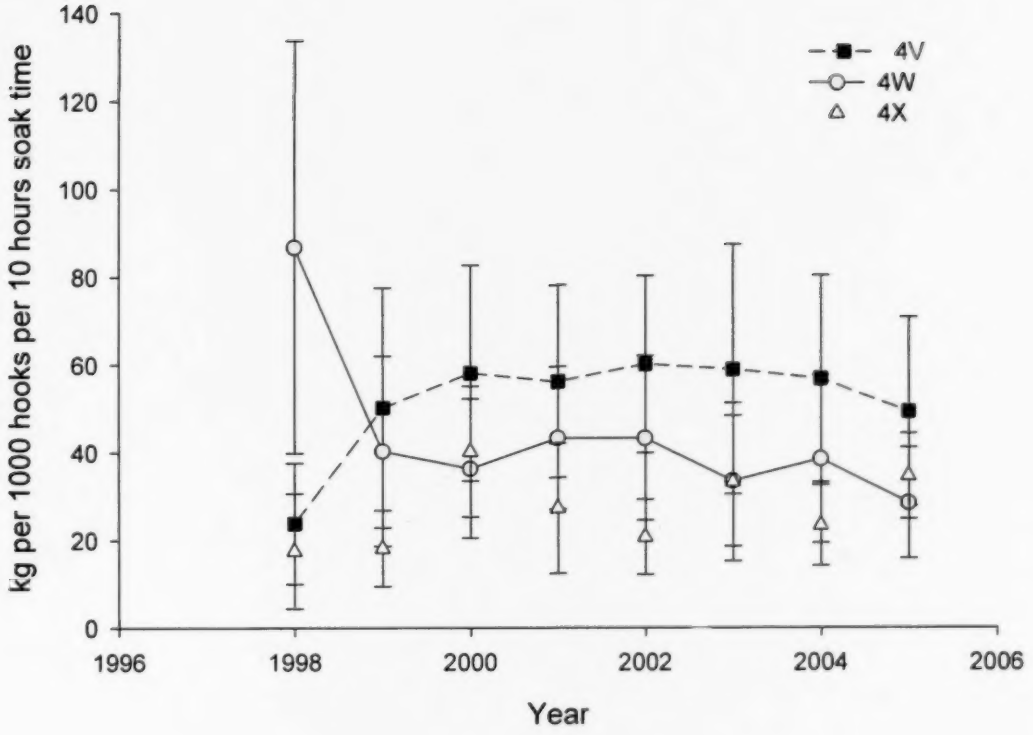


Figure 8. Mean fixed station catch rate (+/- 2SE) of Atlantic halibut by NAFO area for the Scotian Shelf. Analysis includes all 4VWX stations done over the entire halibut survey.

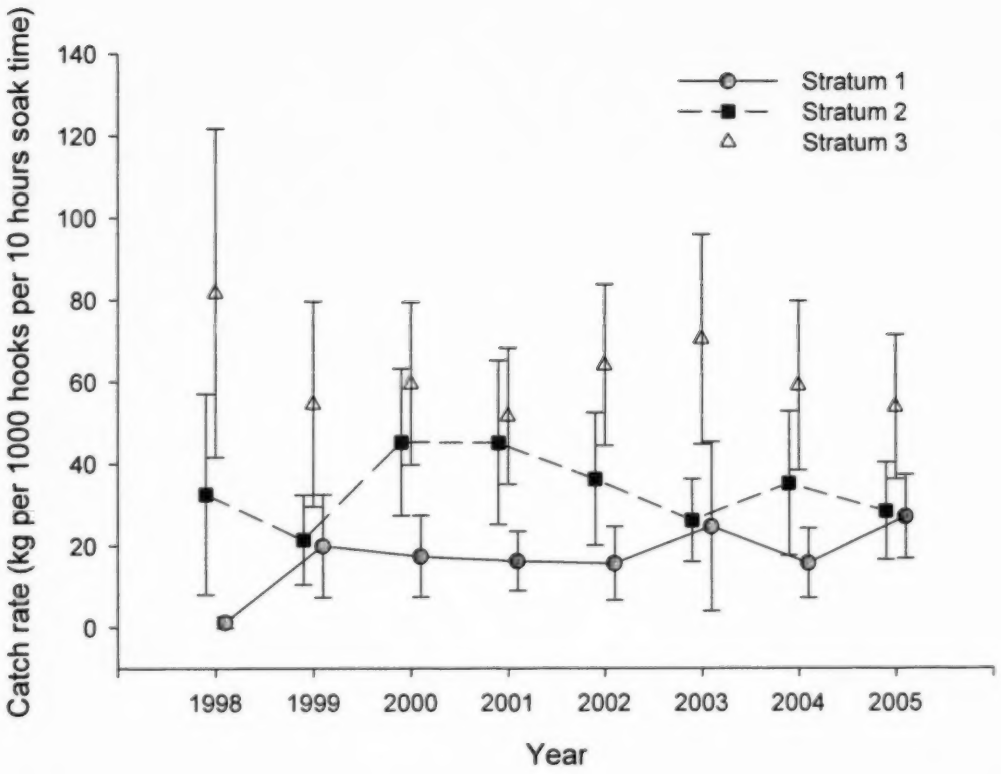


Figure 9. Mean fixed stations catch rate (+/- 2SE) by stratum of Atlantic halibut, Analysis includes all stations done over the entire survey. Note that for stratum 1, a [illegible]y, used in 1998, were abandoned for subsequent

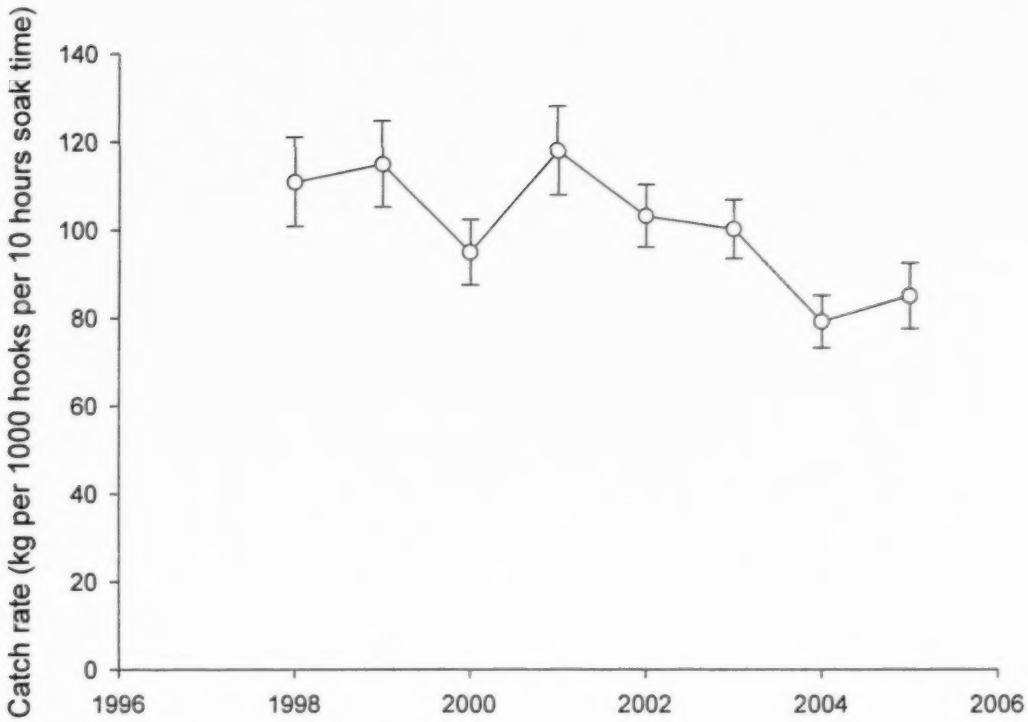


Figure 10. Mean commercial index catch rates (+/- 2SE) for Atlantic halibut in 4VWX from the halibut survey.

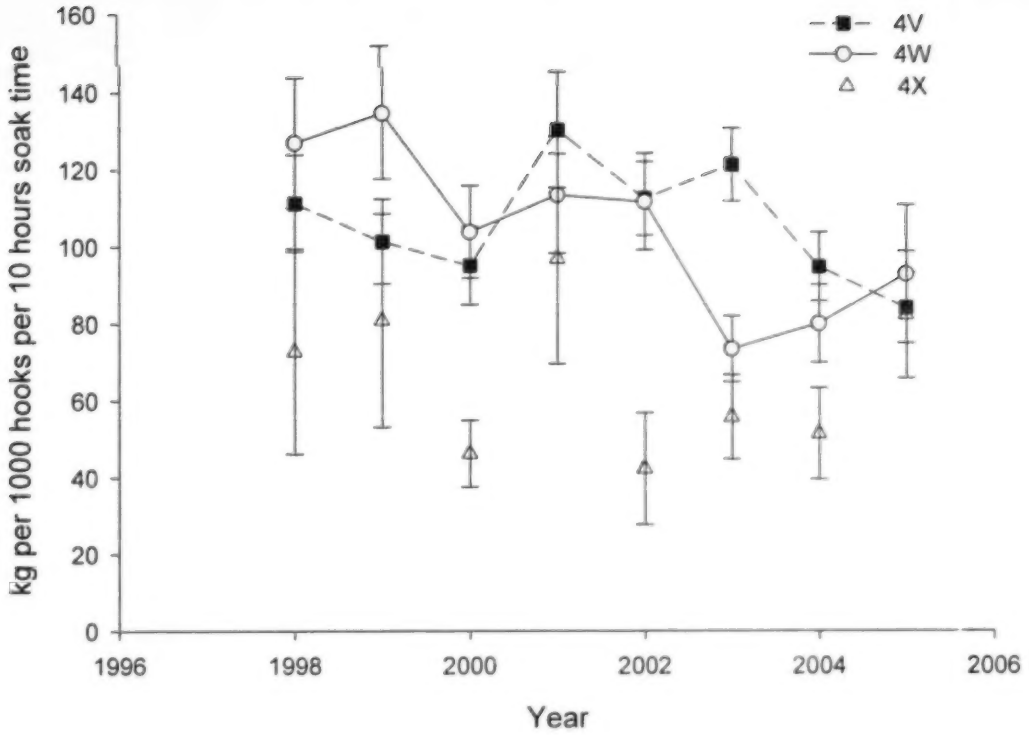


Figure 11. Mean commercial index catch rate (+/- 2SE) of Atlantic halibut by NAFO area for the Scotian Shelf (4VWX) from the halibut survey.

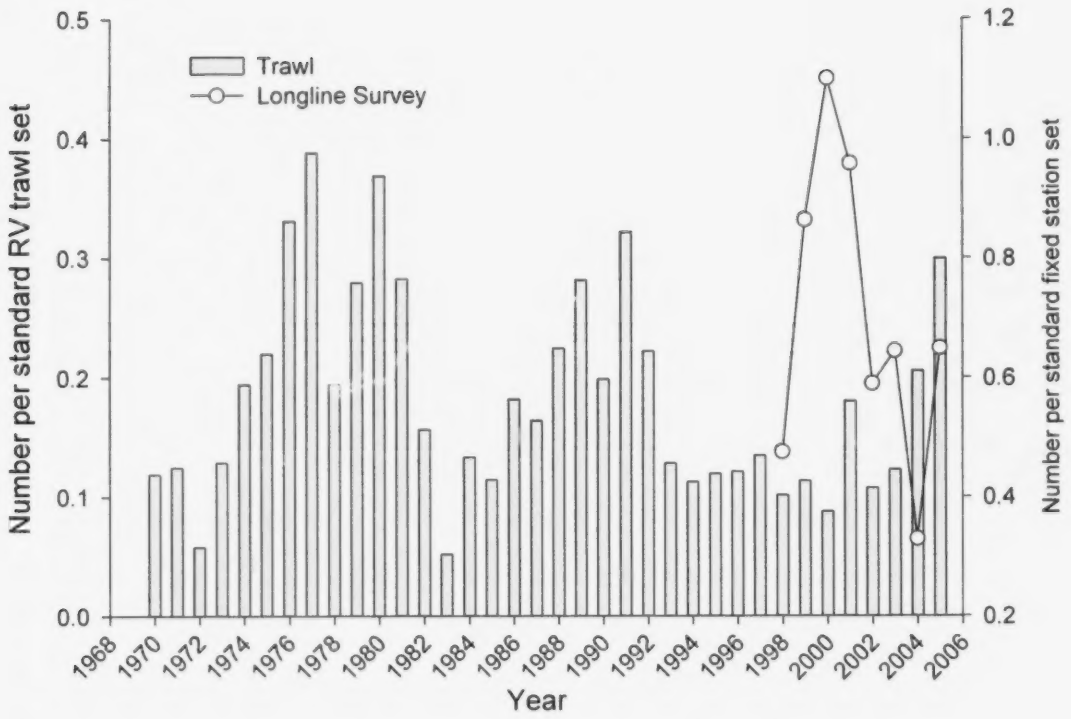


Figure 12. Atlantic halibut pre-recruit (<81cm) catch (number per standard set) from DFO RV trawl survey (bars) and from 4VWX fixed stations in the halibut survey (open circles). All 4VWX stations in the halibut survey were used to estimate the 2005 data point.

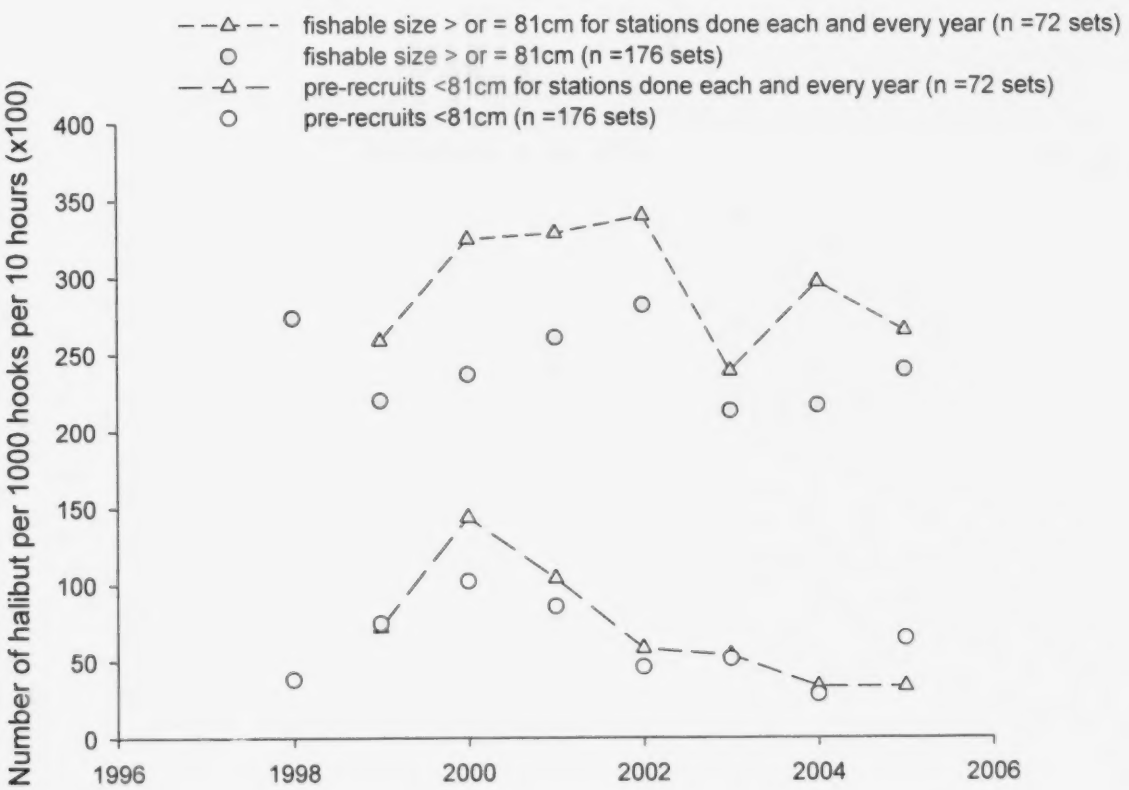


Figure 13. Fixed station catch rates (number) of Atlantic halibut from 4VWX in the halibut survey, separated into pre-recruit (<81cm) and fishable (≥81cm) size classes. The 2005 estimate does not include catch from the four new stations.

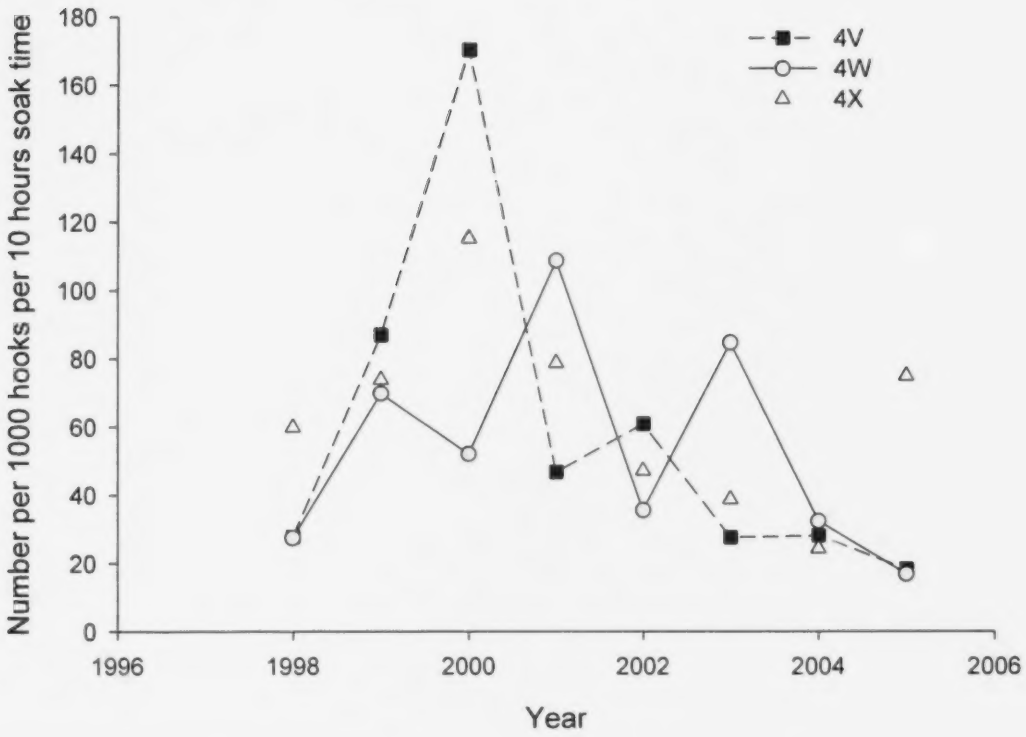


Figure 14. Fixed station catch rates (number) of pre-recruit (<81cm) Atlantic halibut by NAFO area for the Scotian Shelf (4VWX).

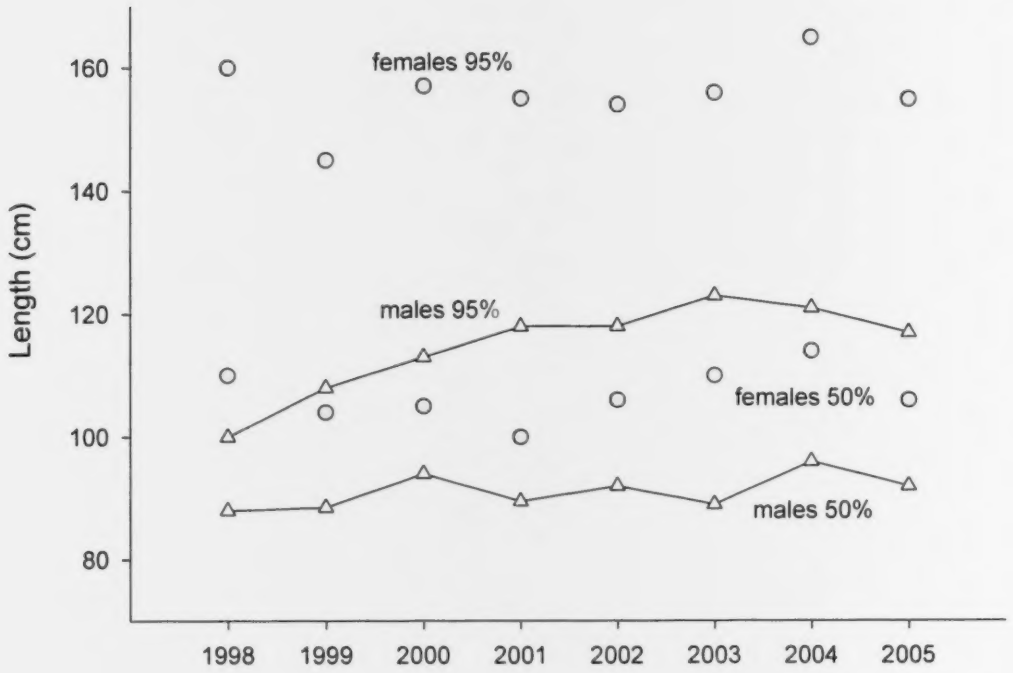


Figure 15. Size composition of Atlantic halibut caught in the 4VWX fixed station [illegible] and 95th percentiles.

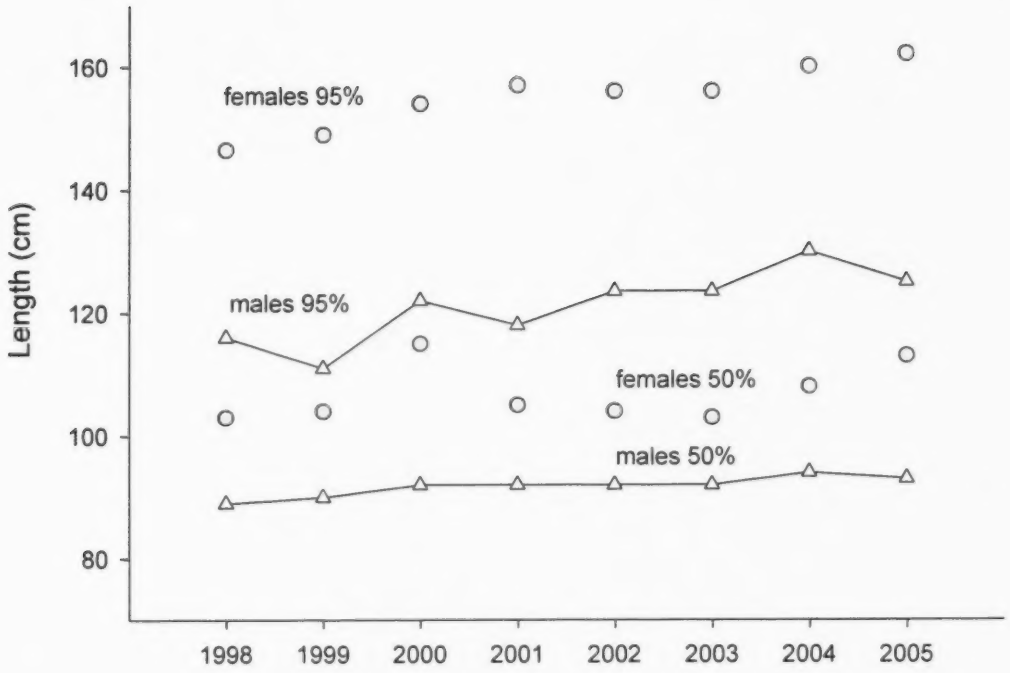


Figure 16. Size composition of Atlantic halibut caught in the commercial index phase in 4VWX, expressed as the median (50%) and 95th percentiles.

Table 1. Total reported landings (t) of Atlantic halibut from 3NOPs4VWX5Zc. Canadian landi present.

| Sub Areas/Divisions | Avg 1960-69 | Avg 1970-79 | Avg[1] 1980-89 | Avg[2] 1990-99 | 2000[3] | 2001[3] | 2002 | 2003 |
|---|---|---|---|---|---|---|---|---|
| TAC (3NOPs4VWX5Zc)[4] | | | | 1855 | 1000 | 1150 | 1150 | 1300 |
| 3NOPs | 996 | 488 | 957 | 487 | 307 | 503 | 483 | 236 |
| 4VWX | 1464 | 850 | 1561 | 820 | 540 | 760 | 765 | 807 |
| 5YZ | 225 | 104 | 133 | 36 | 7 | 13 | 13 | 17 |
| 3NOPs4VWX5Zc Landings | 2685 | 1442 | 2651 | 1343 | 854 | 1276 | 1261 | 1410[4,5] |

[1] Landings prior to 1999 based on January - December calendar year
[2] 1999 landings based on 15 months: January 1999 - March 2000
[3] Landings from 2000 onwards based on April - March fishing year
[4] The Industry / DFO longline survey quota is included in the landings but is not counted against tl
[5] Total landings are from the Canadian Atlantic Quota Report (CAQR); landings for the subareas

Table 2. Industry / DFO Atlantic halibut longline survey catches (t).

| Year | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|
| Fixed Station | 11.8 | 8.6 | 10.6 | 8.9 | 9.3 | 9.0 | 10.6 |
| Comm. Index | 72.6 | 70.0 | 89.6 | 77.7 | 79.5 | 78.7 | 85.9 |
| Total | 84.5 | 78.6 | 100.2 | 86.6 | 89.0 | 87.6 | 96.6 |

Table 3. Vessel participation in the Halibut survey 1998-2005.

| Count of VESSEL | YEAR | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| VESSEL | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | (blank) | Grand Total |
| | | | | | | | | | 1 | 1 |
| AMANDA EUGENE | | | | 1 | 1 | | | | | 2 |
| AQUISITION NO. | | | | | | | 1 | | | 1 |
| ATLANTIC HUNTER | 1 | 1 | 1 | 1 | 1 | 1 | | | | 6 |
| ATLANTIC TRAVEL | | | 1 | | | | | | | 1 |
| ATLANTIC TRAVELLER | | | | 1 | 1 | 1 | | | | 3 |
| BLUE MOOD | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| CAYLYNN ELIZABETH | | | | | 1 | 1 | 1 | 1 | | 4 |
| COURTNEY & KIARA | | | | | | | | 1 | | 1 |
| CRISSY MARIA | 1 | 1 | 1 | 1 | 1 | | | | | 5 |
| DARREN AND RANDY | | 1 | 1 | 1 | 1 | 1 | 1 | | | 6 |
| E.T. II | 1 | | 1 | | | | | | | 2 |
| EMILY LISA | | | | | | 1 | 1 | 1 | | 3 |
| FORTY ROSES | | | | | | 1 | 1 | 1 | | 3 |
| JOHN AND RONNIE | | | | | | | | 1 | | 1 |
| LITTLE GRAND BANKER | | 1 | | | | | | | | 1 |
| MABEL KATHLEEN | 1 | 1 | 1 | | | | | | | 3 |
| MARTHA BELLE | | | | | | | | 1 | | 1 |
| MELODY ROSE III | 1 | | | | | | | | | 1 |
| MISS FORTUNE I | 1 | | | | | | | | | 1 |
| MY GIRL | 1 | | | | | | | | | 1 |
| NAKED GUN | 1 | | | | | | | | | 1 |
| NEVER SURRENDER | | | | | | 1 | 1 | 1 | | 3 |
| NICOLE AND SISTERS II | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| NOVEMBER DAWN | | | | | | | | 1 | | 1 |
| OUR MAC | | | | 1 | 1 | | | | | 2 |
| PAT AND JENNIFER | 1 | 1 | 1 | | 1 | | | | | 4 |
| PENNY LANE III | 1 | 1 | 1 | | | | | | | 3 |
| PHYLLIS AND HEATHER | 1 | | | | | | | | | 1 |
| RYAN R | 1 | 1 | 1 | | | | | | | 3 |
| SANDY AND SHELLY | | | | 1 | 1 | 1 | 1 | | | 4 |
| SCOTTY N SISTERS | 1 | 1 | 1 | | | | | | | 3 |
| SHELLEY DAWN II | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | 7 |
| SHORT N SASSY | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| Grand Total | 17 | 13 | 14 | 11 | 13 | 12 | 11 | 11 | 1 | 103 |

Table 4. Station locations completed each year in the halibut survey 1999-2005. A blank box indicates the station was not done. 1998 was excluded from analyses.

| Stn # | '99 | '00 | '01 | '02 | '03 | '04 | '05 | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 4 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 5 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 7 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 8 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 9 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 10 | | 1 | 1 | 1 | 1 | | | 4 |
| 11 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 12 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 13 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 14 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 15 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 16 | 1 | | 1 | 1 | | 1 | 1 | 5 |
| 17 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 18 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 19 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 20 | 1 | | 1 | 1 | 1 | | 1 | 5 |
| 21 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 22 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 23 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 24 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 25 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 26 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 27 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 28 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 29 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 30 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 31 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 32 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 33 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 34 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 35 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 36 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 37 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 38 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 39 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 40 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 41 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 42 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 43 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 44 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 45 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |

| Stn # | '99 | '00 | '01 | '02 | '03 | '04 | '05 | Total |
|---|---|---|---|---|---|---|---|---|
| 46 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 47 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 48 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 49 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 50 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 51 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 52 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 53 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 54 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 55 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 56 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 57 | | | 1 | 1 | 1 | 1 | | 4 |
| 58 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 59 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 60 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 61 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 62 | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 63 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 64 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 65 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| 66 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| 67 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 68 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 69 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 70 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 71 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 72 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 73 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 74 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 75 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 76 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 77 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 78 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 79 | | 1 | 1 | 1 | | 1 | 1 | 5 |
| 80 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 81 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 82 | 1 | 1 | 1 | 1 | | 1 | | 5 |
| 83 | 1 | 1 | | | | | | 2 |
| 84 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 85 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 86 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 87 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 88 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| 89 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 90 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| Stn # | '99 | '00 | '01 | '02 | '03 | '04 | '05 | Total |
| 91 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 92 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 93 | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 94 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 95 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 96 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 97 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 98 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 99 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 100 | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 101 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 102 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 103 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 120 | 1 | 1 | 1 | 1 | | 1 | | 5 |
| 121 | 1 | 1 | 1 | | | 1 | | 4 |
| 122 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 123 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 124 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 125 | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 126 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 127 | 1 | 1 | 1 | 1 | | 1 | | 5 |
| 128 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 129 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 130 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 131 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 132 | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 133 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 134 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 135 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 136 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 137 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 138 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 139 | 1 | 1 | | 1 | 1 | 1 | 1 | 6 |
| 140 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 141 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 142 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 143 | | 1 | 1 | 1 | 1 | 1 | | 5 |
| 144 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 145 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 146 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 147 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 148 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 149 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 150 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 151 | 1 | 1 | | | | 1 | 1 | 4 |
| 152 | 1 | 1 | 1 | 1 | 1 | | 1 | 6 |
| 153 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| Stn # | '99 | '00 | '01 | '02 | '03 | '04 | '05 | Total |
| 154 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 155 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 156 | | 1 | 1 | 1 | | 1 | | 4 |
| 157 | 1 | 1 | 1 | 1 | | 1 | | 5 |
| 158 | 1 | 1 | | 1 | 1 | | | 4 |
| 159 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 160 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 161 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 162 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 163 | 1 | | 1 | 1 | 1 | 1 | | 5 |
| 164 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 165 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 166 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 167 | 1 | 1 | 1 | 1 | | 1 | | 5 |
| 168 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 169 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 170 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 171 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 172 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 173 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 174 | 1 | 1 | | | | | | 2 |
| 175 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 176 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 177 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 7 |
| 178 | | 1 | 1 | 1 | | 1 | | 4 |
| 179 | | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 180 | | 1 | | 1 | 1 | 1 | | 4 |
| 181 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 182 | | 1 | | 1 | | 1 | | 3 |
| 183 | | 1 | | 1 | | 1 | | 3 |
| 184 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 185 | | | | 1 | 1 | 1 | 1 | 4 |
| 186 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 187 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 188 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 189 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 190 | | 1 | | 1 | 1 | 1 | 1 | 5 |
| 191 | 1 | 1 | 1 | | 1 | 1 | | 5 |
| 192 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 193 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 194 | 1 | 1 | 1 | 1 | | 1 | | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 195 | 1 | 1 | 1 | | | | | 3 |
| 196 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 197 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| 198 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| 199 | 1 | 1 | 1 | | | | | 3 |
| 200 | 1 | | | 1 | | 1 | | 3 |
| Stn # | '99 | '00 | '01 | '02 | '03 | '04 | '05 | Total |
| 201 | 1 | | | | | 1 | 1 | 3 |
| 202 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 203 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 204 | | 1 | | | | 1 | 1 | 3 |
| 205 | | 1 | | | | 1 | | 2 |
| 206 | 1 | 1 | | 1 | 1 | 1 | | 5 |
| 207 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 208 | 1 | 1 | | 1 | 1 | 1 | | 5 |
| 209 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 210 | 1 | 1 | | 1 | | 1 | 1 | 5 |
| 211 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 212 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 213 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 214 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 215 | 1 | 1 | | | | 2 | 1 | 5 |
| 216 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 217 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 218 | 1 | 1 | | | | 1 | | 3 |
| 219 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 220 | 1 | 1 | 1 | | | | | 3 |
| 221 | 1 | 1 | 1 | | | 1 | | 4 |
| 222 | 1 | 1 | | | | 1 | 1 | 4 |
| 223 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 224 | 1 | 1 | 1 | | | | | 3 |
| 225 | 1 | 1 | | | | 1 | | 3 |
| 226 | 1 | 1 | | | | | | 2 |
| 227 | 1 | 1 | | 1 | | 1 | 1 | 5 |
| 228 | 1 | 1 | | 1 | 1 | 1 | | 5 |
| 229 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 230 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 231 | 1 | 1 | 1 | | | 1 | 1 | 5 |
| 232 | 1 | 1 | | | | 1 | | 3 |
| 233 | 1 | 1 | | | | 1 | | 3 |
| 234 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| 235 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 236 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 237 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 238 | 1 | 1 | 1 | | | | | 3 |
| 239 | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 240 | 1 | 1 | 1 | 1 | 1 | | | 5 |
| Stn # | '99 | '00 | '01 | '02 | '03 | '04 | '05 | Total |
| 265 | | | | 1 | | 1 | | 2 |
| 266 | | | | 1 | 1 | 1 | 1 | 4 |
| 267 | | | | 1 | 1 | 1 | 1 | 4 |
| 268 | | | | | 1 | 1 | | 2 |
| 269 | | | | 1 | 1 | 1 | 1 | 4 |
| 270 | | | | 1 | 1 | 1 | 1 | 4 |
| 271 | | | | | 1 | | | 1 |
| 272 | | | | 1 | 1 | 1 | 1 | 4 |
| 273 | | | | 1 | 1 | 1 | 1 | 4 |
| 274 | | | | 1 | 1 | 1 | 1 | 4 |
| 275 | | | | 1 | 1 | 1 | 1 | 4 |
| 276 | | | | 1 | 1 | 1 | 1 | 4 |
| 277 | | | | 1 | 1 | 1 | 1 | 4 |
| 278 | | | | 1 | 1 | 1 | 1 | 4 |
| 279 | | | | 1 | 1 | 1 | 1 | 4 |
| 280 | | | 1 | 1 | 1 | 1 | | 4 |
| 281 | | | 1 | 1 | 1 | 1 | | 4 |
| 282 | | | 1 | 1 | 1 | 1 | | 4 |
| 283 | | | | 1 | 1 | 1 | 1 | 4 |
| 284 | | | | 1 | 1 | 1 | 1 | 4 |
| 285 | | | | 1 | 1 | | 1 | 3 |
| 286 | | | | | 1 | 1 | 1 | 3 |
| 287 | | | | | 1 | 1 | 1 | 3 |
| 288 | | | | | 1 | 1 | 1 | 3 |
| 289 | | | | | | 1 | | 1 |
| 293 | | | | | | | 1 | 1 |
| 294 | | | | | | | 1 | 1 |
| 296 | | | | | | | 1 | 1 |
| 297 | | | | | | | 1 | 1 |
| 298 | | | | | | | 1 | 1 |
| 299 | | | | | | 1 | | 1 |
| 300 | | | | | | 1 | | 1 |
| 301 | | | | | | 1 | 1 | 2 |
| 302 | | | | | | 1 | 1 | 2 |
| 312 | | | | | | 1 | 1 | 2 |
| 313 | | | | | | | 1 | 1 |
| 314 | | | | | | | 1 | 1 |
| 315 | | | | | | | 1 | 1 |
| 316 | | | | | | | 1 | 1 |
| Total | 175 | 217 | 192 | 208 | 192 | 225 | 176 | 1385 |

Table 5. GLM Summary Table; year has no effect on catch, but station has a significant effect.

Negative Binomial Model
Analysis of Deviance Table
Response: BOTHWGT
Terms added sequentially (first to last)

| | Df | Deviance | Resid. Df | Resid. Dev. | *F* Value | Pr (*F*) |
|---|---|---|---|---|---|---|
| Null | | | 1443 | 2675 | | |
| YR | 7 | 1 | 1436 | 2674 | 0.323 | 0.944 |
| Station | 260 | 1282 | 1176 | 1392 | 8.063 | 0.000 |

Call: glm.nb (formula = BOTHWGT ~ YR + STATIONS, data = halibut.selected, init.theta = 0.0373, link = log)